

Requirements and Achievements in Post Construction Energy Yield Assessment

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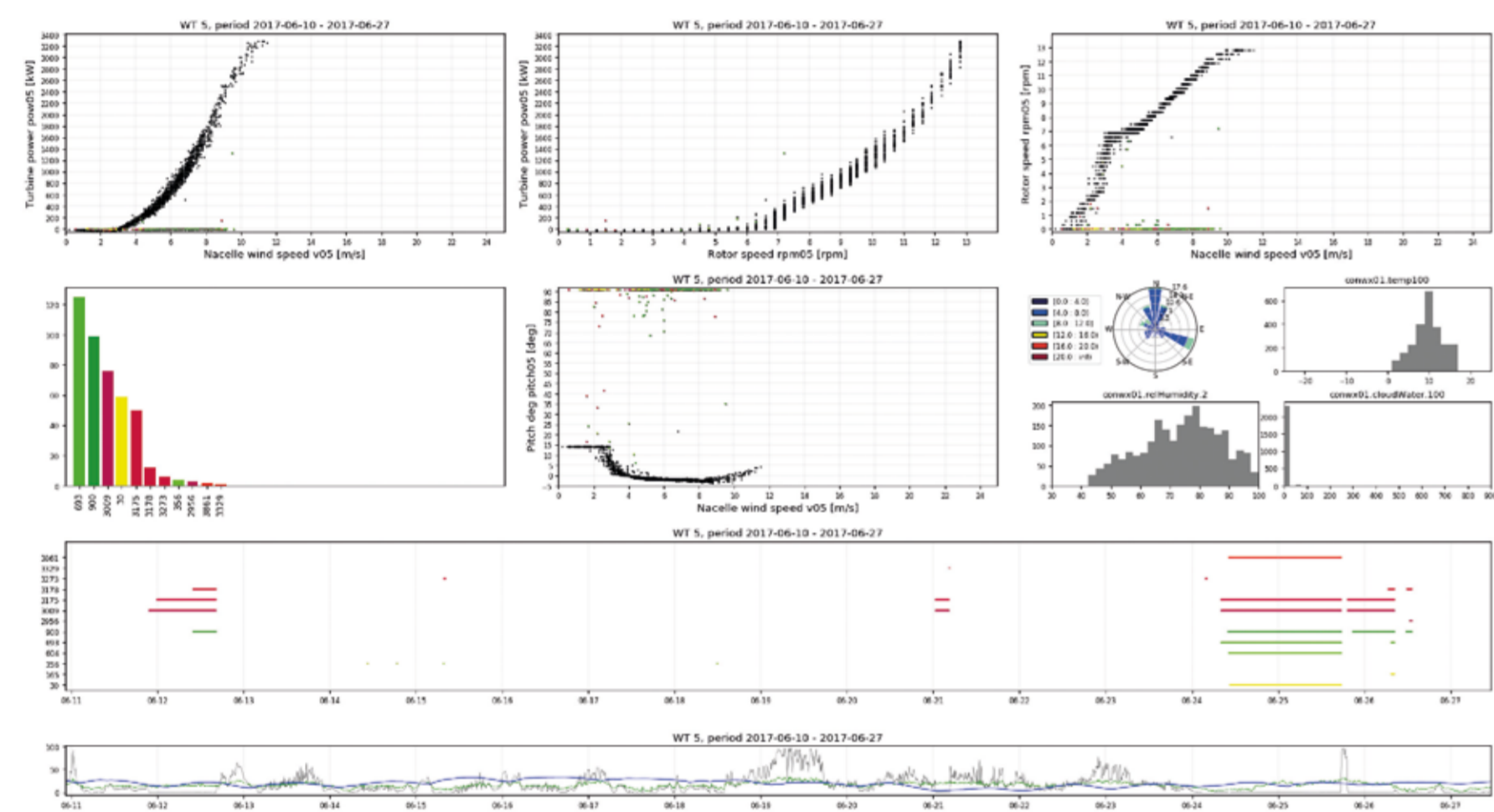
Introduction

The post construction energy yield assessment is an important measure to provide the most accurate view on the long term expectancy of the project revenue.

Procedures which have been applied by the presenter for several GW of installed capacity, within the scope of project evaluation, vending or refinancing processes, is sketched on this poster.

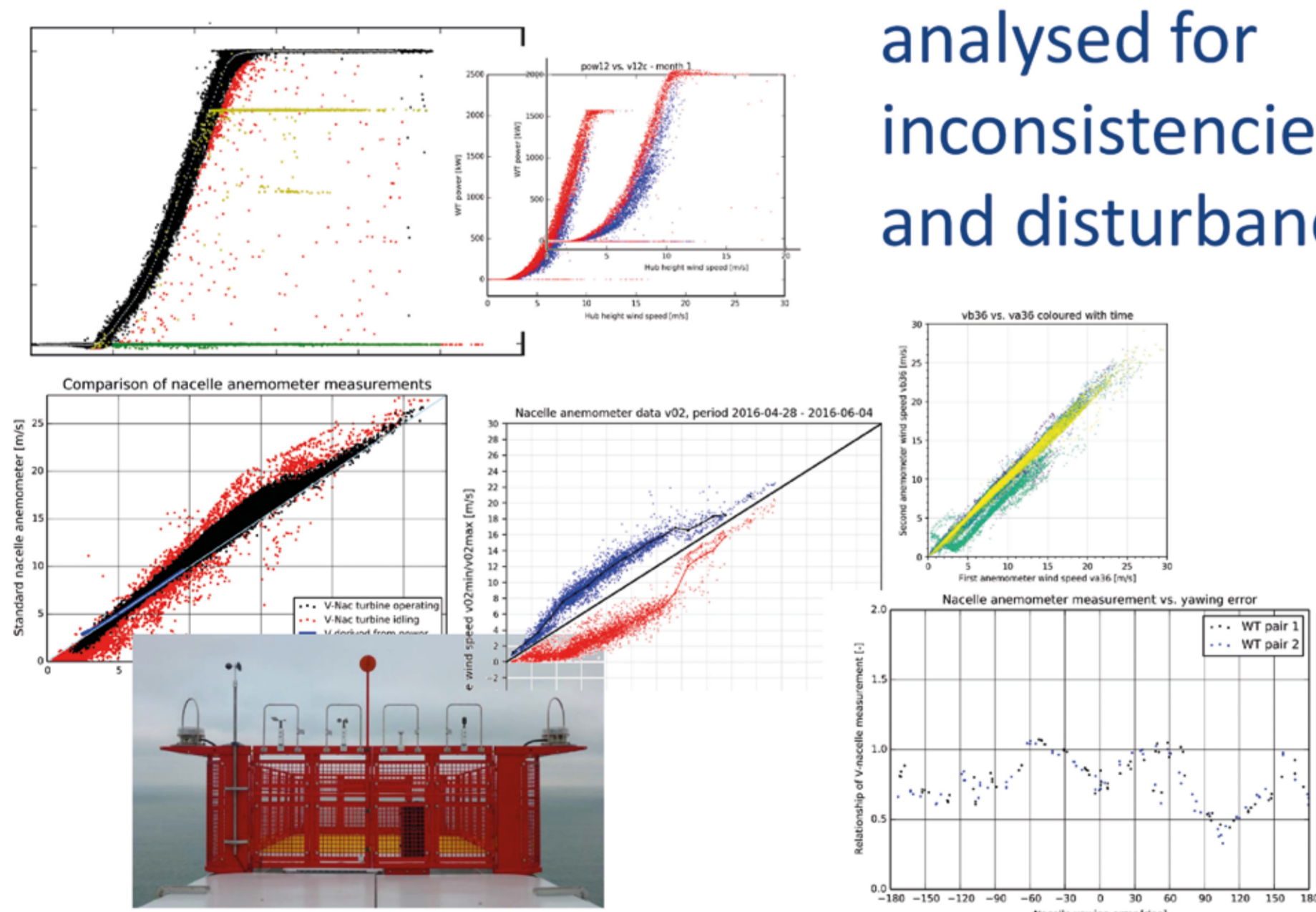
Analysing the Operation

A thorough analysis of the SCADA data is done to understand operational issues, the reasons and representation by the event log. This is important for data filtering and appropriate determination of operational losses.



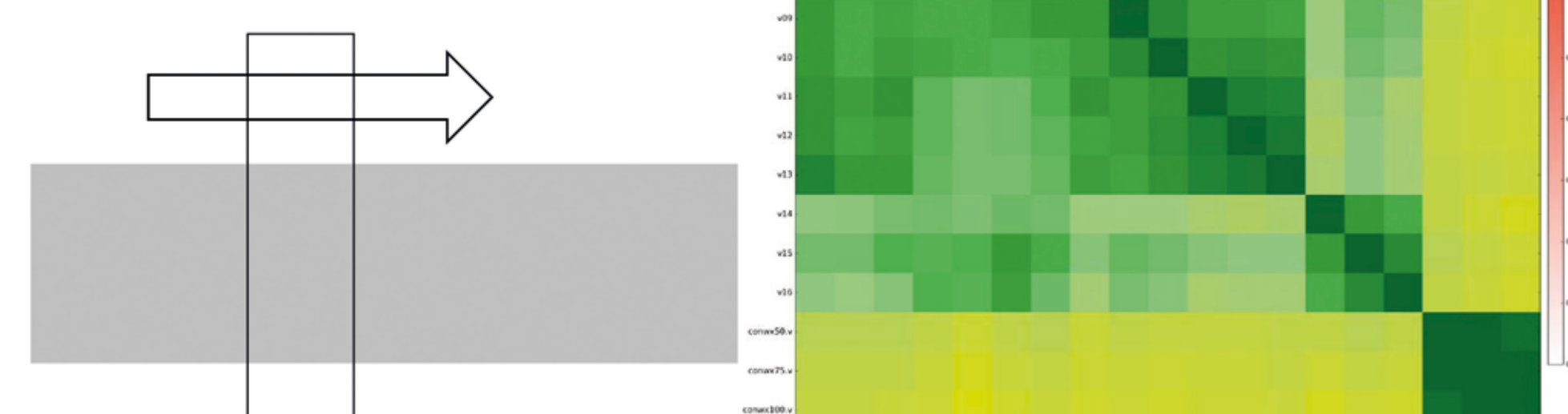
Data Filtering

The turbine data needs to be filtered in order to determine regular turbine behaviour. Also the nacelle anemometer data needs to be analysed for inconsistencies and disturbances.

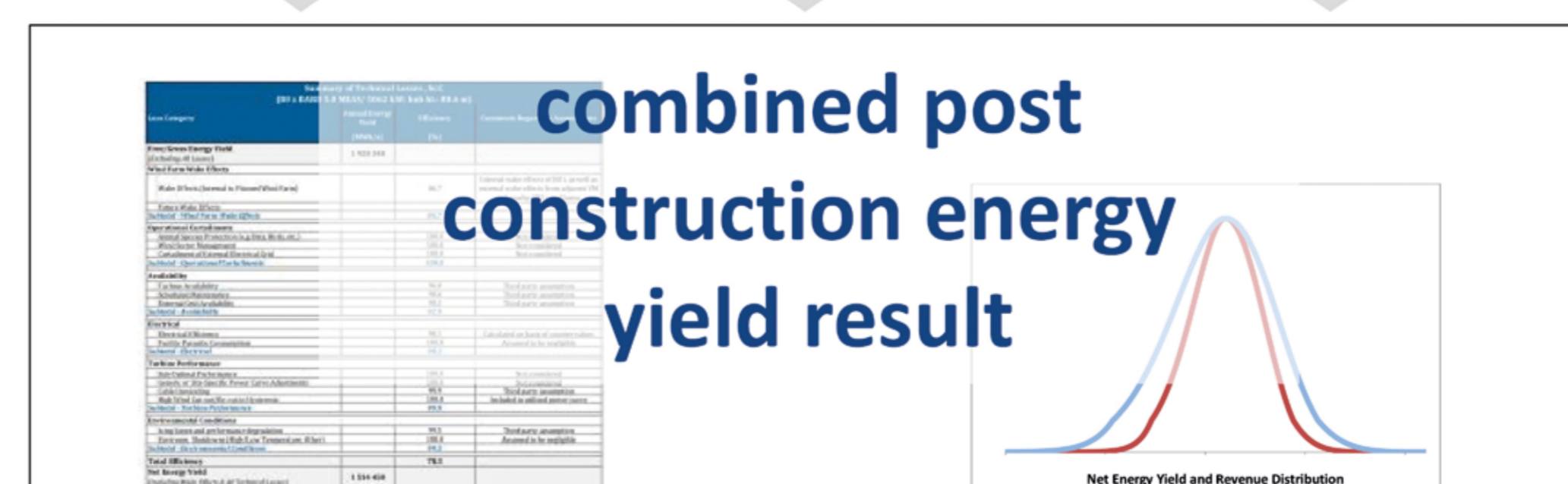
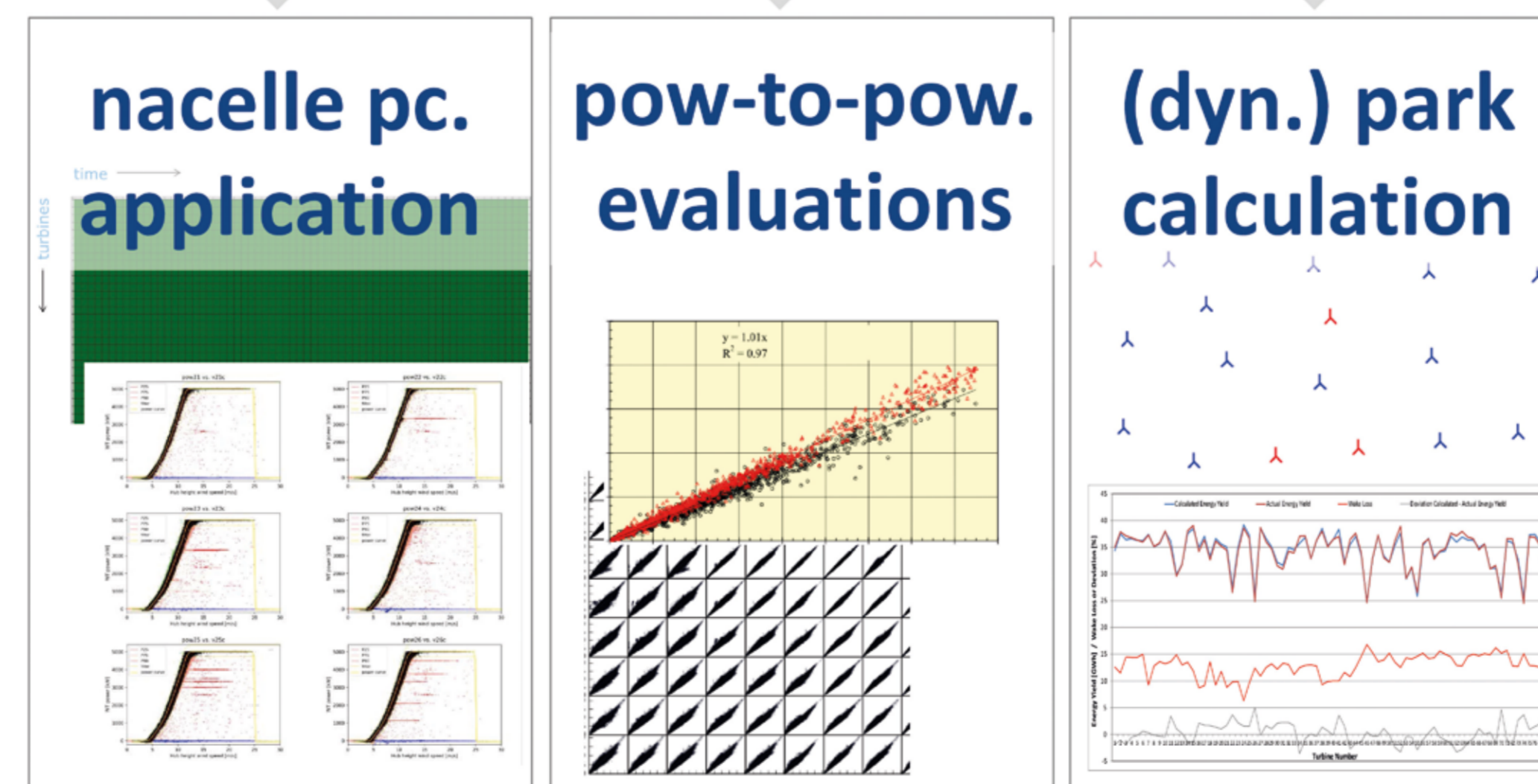
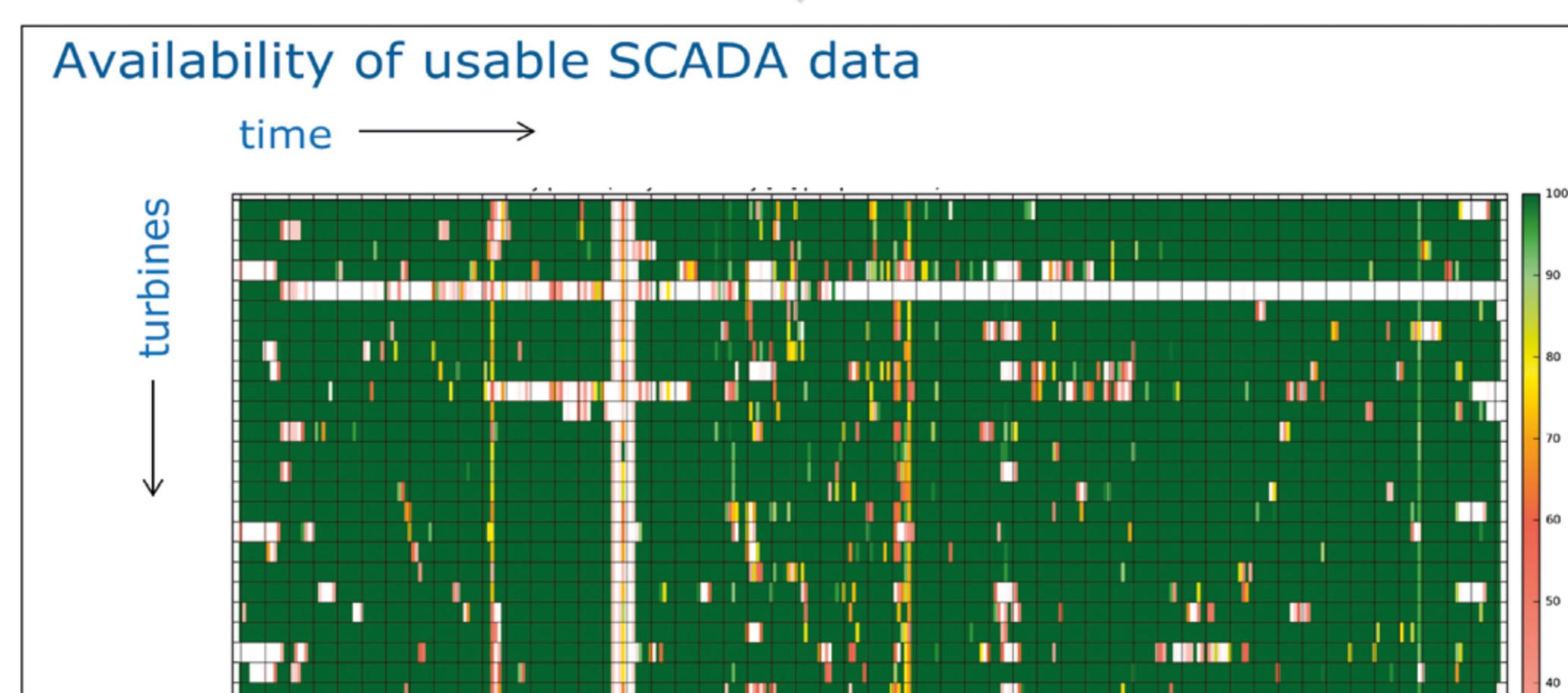
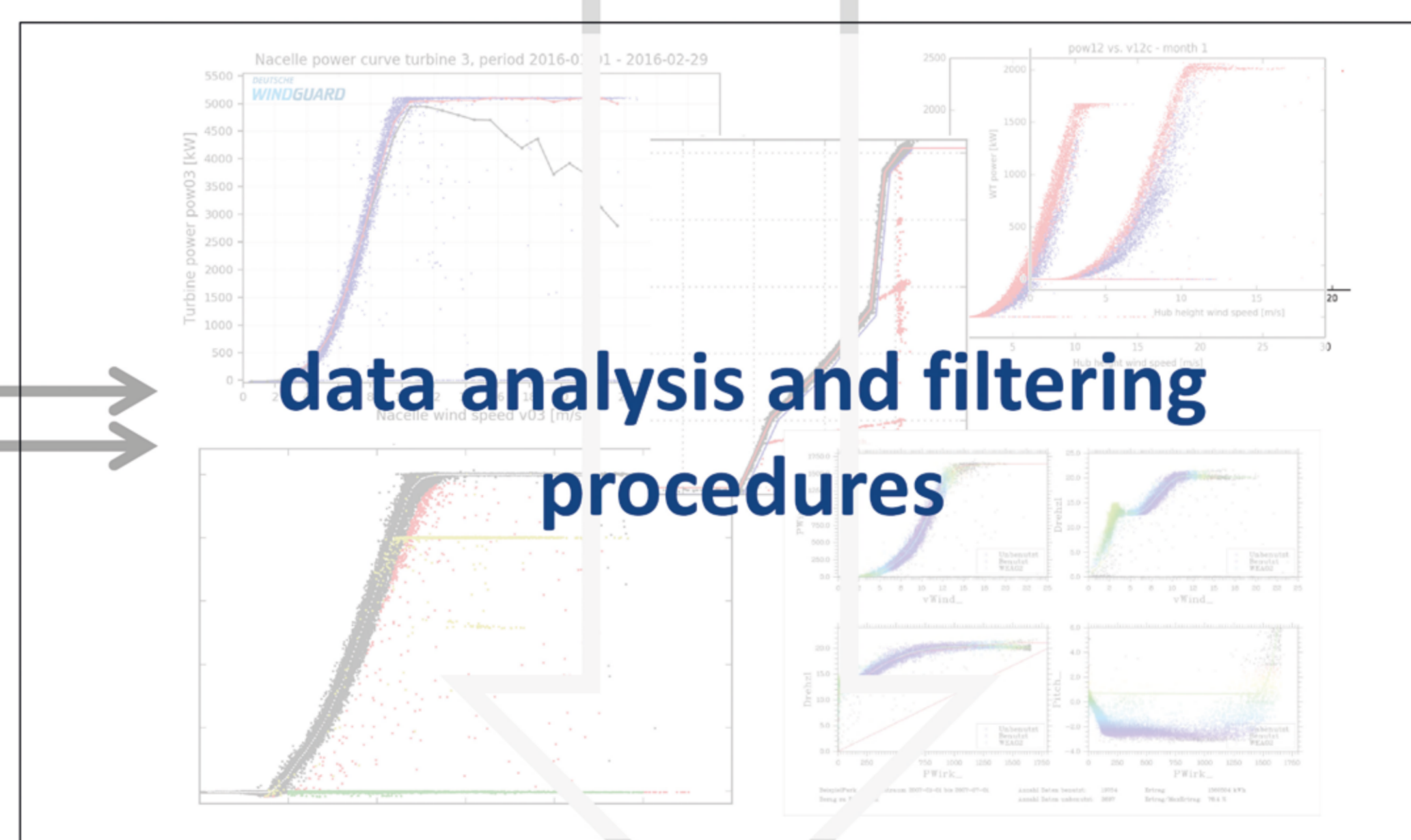
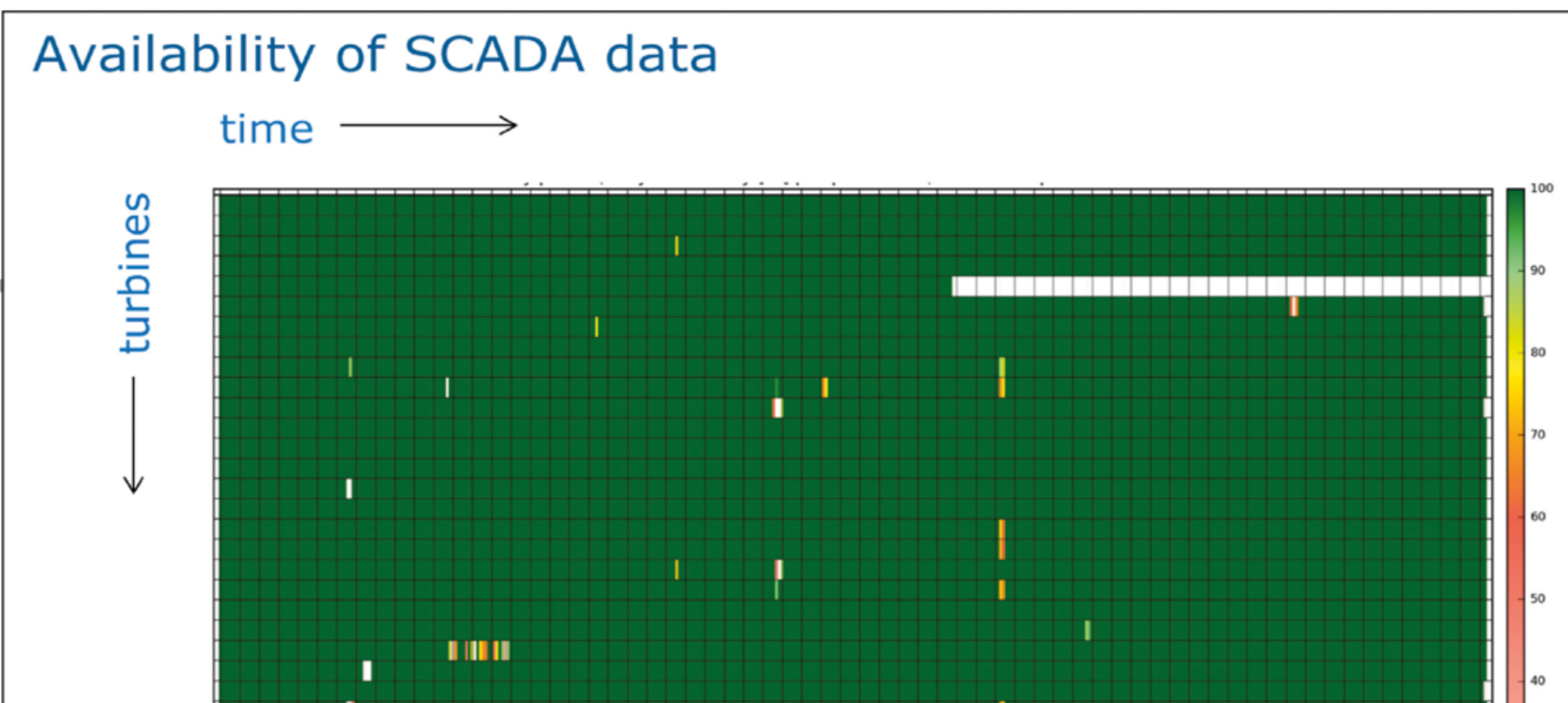
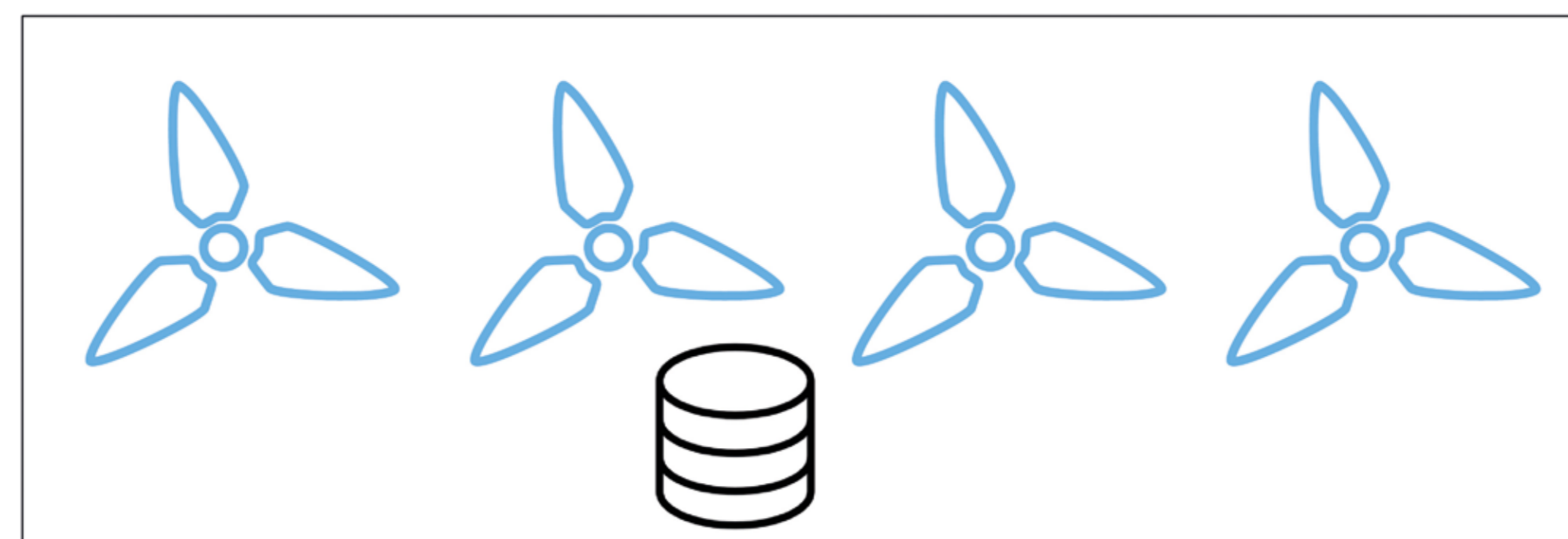


Data Filling

Nacelle anemometer are very useful for operational data assessment, but inconsistent data must be rejected and reconstructed. A multi-correlation procedure has been developed for this.

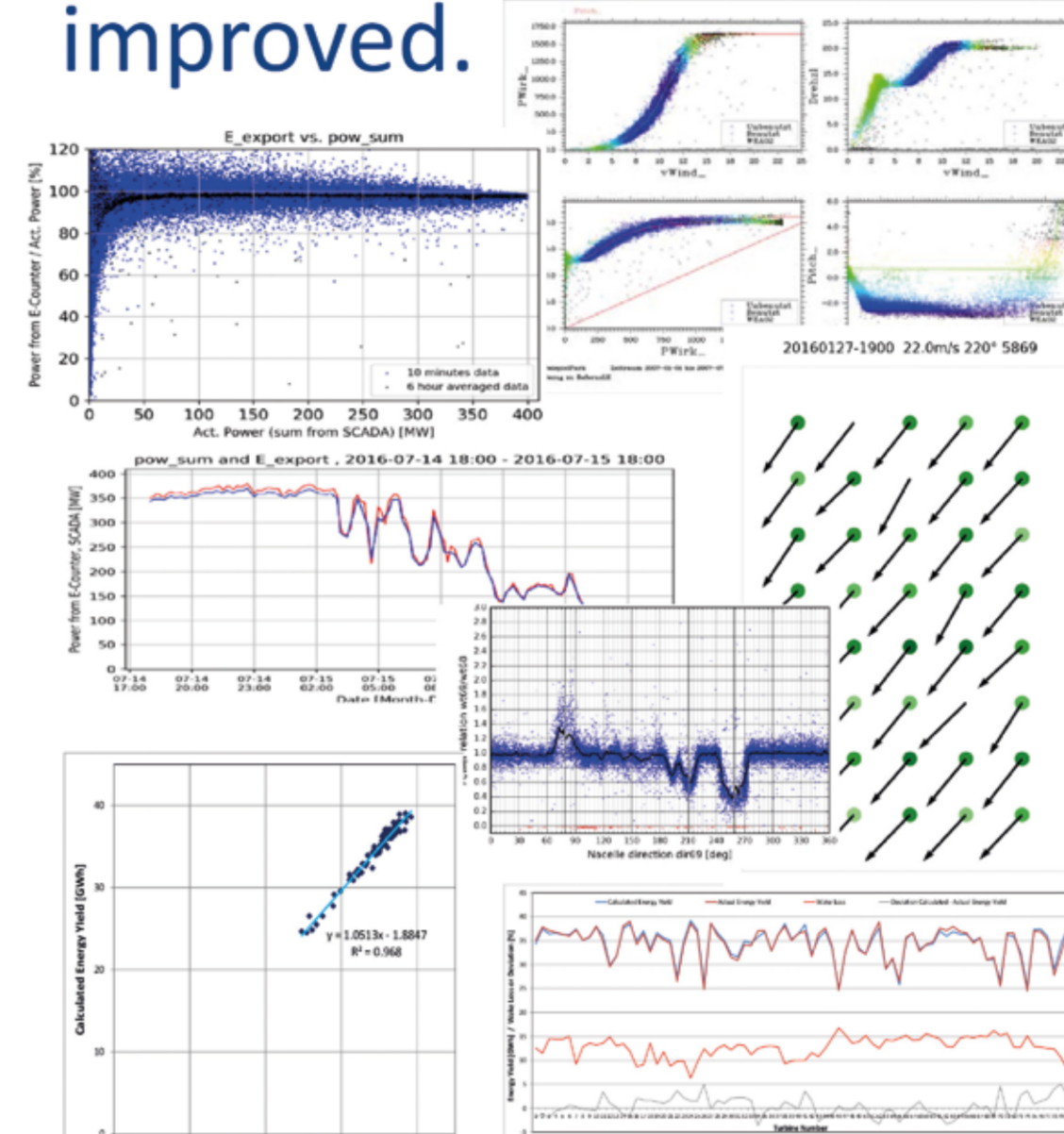


Assessment Procedure



Loss Analysis

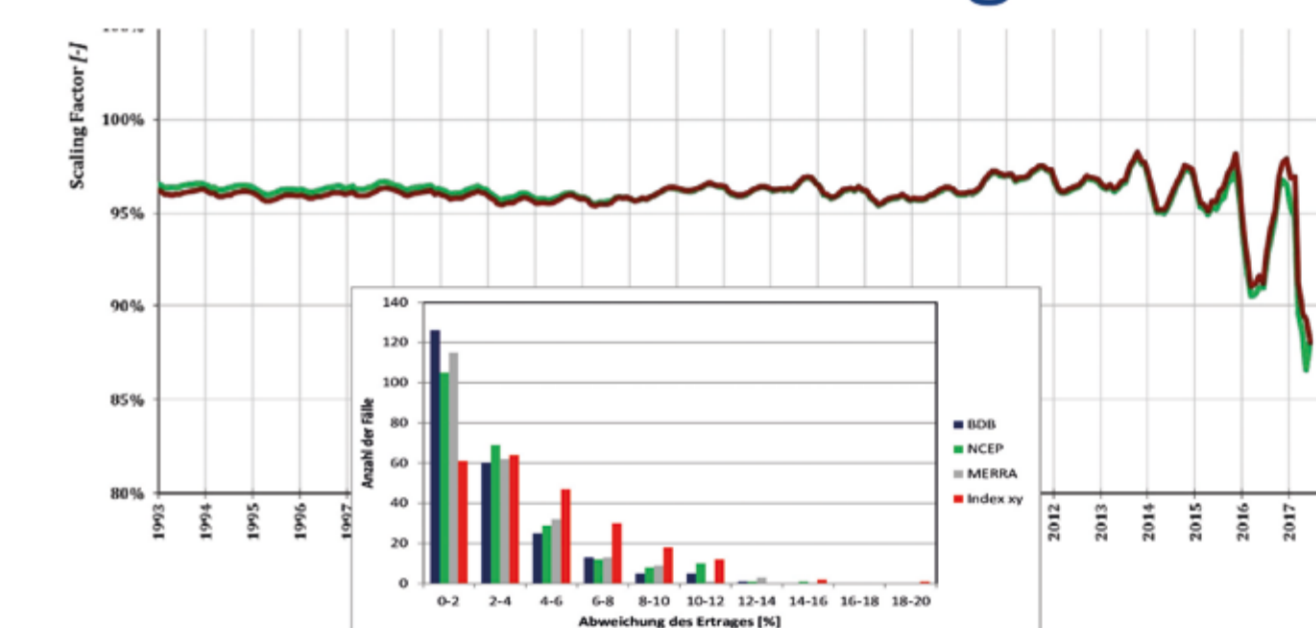
The losses can be assessed in realistic way on basis of operational data. Optimisation potential can be assessed and the future operation improved.



- Control losses
- Availability
- Electrical
- Icing losses
- Wake Losses, based on validation
- Future changes

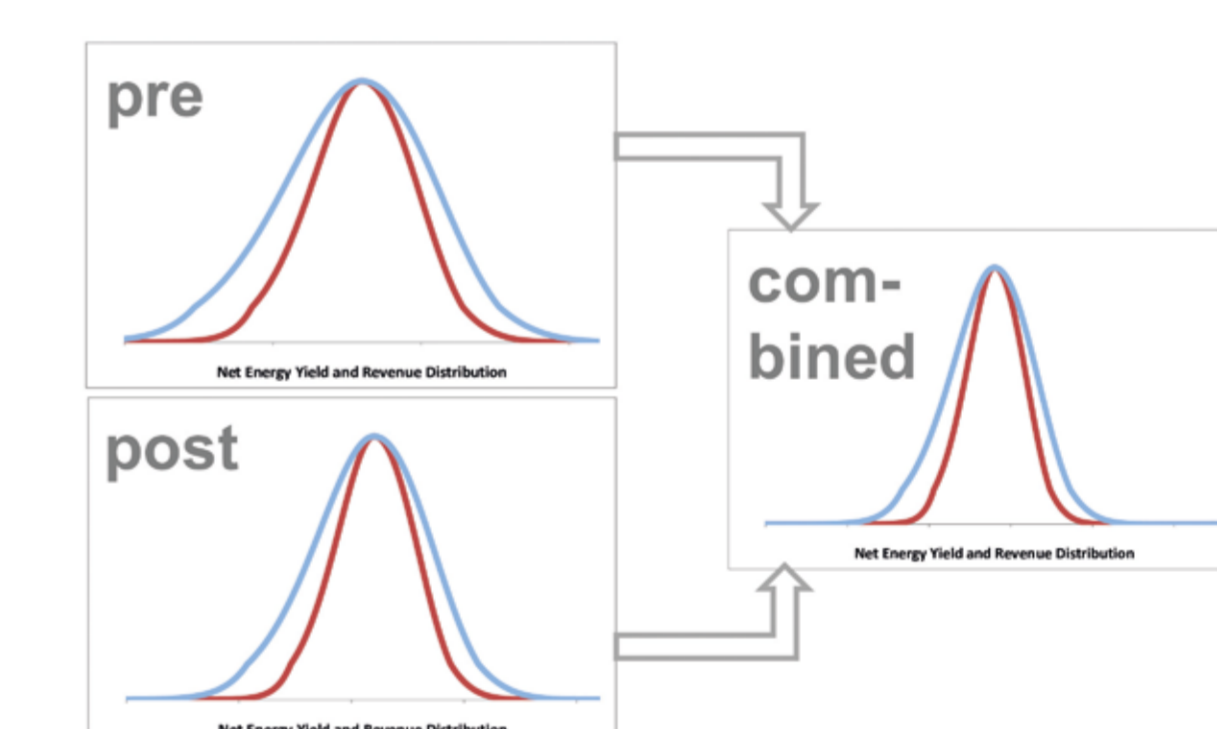
Long Term Assessment

Long term assessment is mostly the largest uncertainty component. A thorough analysis of data sources and good methodology is important to get a realistic result.



Energy Yield & Uncertainty

The post construction energy yield assessment normally will reduce the uncertainties considerably. A combination with measurement based assessment can further improve.



Exemplary off-shore case:
 $Unc_{pre} = 9.8\%$
 $Unc_{post} = 6.7\%$
 $Unc_{comb} = 6.3\%$

Conclusions

Suitable post construction energy yield assessment give an accurate view on long-term energy yield, losses and performance. Uncertainties reduce, so that even when P50 needs to be adjusted, mostly the P90 increases, which is valuable for adjusting financing conditions.

References

- We like to thank the following companies for authorizing to use their results for some of the following references: DanTysk Offshore Wind GmbH (Vattenfall and Stadtwerke München) and Offshore-Wind-park RIFFGAT GmbH & Co. KG (EWE AG).
- [1] Martin Strack: Quantification of grid related energy yield losses: Experience gained in German offshore projects. Contribution to WindEurope Summit 2016, Hamburg, Germany and German Wind Energy Conference (DEWEK) 2017, Bremen, Germany.
 - [2] Martin Strack et al.: Big data approach of wind resource and operational data analysis in cold climate. Presentation held at WindEurope Summit 2016, Hamburg, Germany and German Wind Energy Conference (DEWEK) 2017, Bremen, Germany
 - [3] Fördergesellschaft Windenergie (FGW) TR 10.

